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PHILOSOPHY OF SCIENCE

SAINT THOMAS AQUINAS' DIVISION OF THE SCIENCES

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Saint Thomas Aquinas holds that scientific knowledge is attained when observable phenomena and their properties are accounted for in terms of their relations to their causes. On establishing the divisions of the sciences, Aquinas follows the threefold division of the speculative sciences as proposed by Aristotle and handed on to the Middle Ages by Boethius: natural philosophy, mathematics, and theology. Each science is defined by its subject matter and by its method of procedure.

While Aquinas followed the teachings of Boethius on this point, he makes significant additions and alterations. Thus in his analysis Aquinas focuses his attention on the role played by the intellect in the determination of the formal perspective (ratio) from which the intellect considers the various matters of science.

For Aquinas the intellect performs two operations: apprehension and judgment. Here we shall be concerned with the operation of apprehension. This operation of the intellect is capable of two distinct kinds of abstraction. First, there is the abstraction of form from sensible matter. Second, there is the abstraction by which a universal is abstracted from its particular. The objects of the operation called abstraction of form are the objects of mathematics, and the objects of the abstraction of the universal are the objects of science. Hence, the intellect by means of its powers of abstraction plays a fundamental role in establishing the division of the sciences.

† † †

While Saint Thomas draws no clear distinction between science and philosophy, today many philosophers and scientists sharply distinguish between the two enterprises. In this century an ideal of scientific knowledge is mathematical physics with its use of precise calculations and a highly refined method involving experimentation, formation of hypotheses, and their verification. Aquinas' ideal, however, is different. Aquinas holds there are four distinct types of cause: material, formal, final, and efficient. Scientific knowledge is a knowledge of things through these causes. Following Aristotle's lead, Aquinas holds that scientific knowledge is attained when "... we know the cause on which the fact depends, as the cause of that fact and of no other, and, further, that the fact could not be other than it is" (Aquinas, 1955, 1941).

For Saint Thomas, scientific knowledge is not attained by recording observable connections in nature and then calculating them in mathematical terms. When the observable phenomena of nature and their properties are accounted for in terms of their necessary relations to their causes, then we have scientific knowledge. Insofar as we pursue a knowledge of nature through its causes, our inquiry, according to Aquinas, will ultimately be metaphysical; this is science at its best. Science, then, does not aim at empirical knowledge gained through experimentation, but rather at a knowledge of the being and intelligible structures of things as seen in relation to their ultimate causes. In short, Aquinas holds the goal of scientific inquiry to be metaphysical, not empirical.

Saint Thomas gives his views on the hierarchy and methodology of the sciences in several of his works, but his most extensive and penetrating treatment of these subjects can be found in Questions Five and Six of his unfinished "Commentary on Boethius' De Trinitate." In this paper I will center my attention on this work.

Aquinas follows the threefold division of the speculative sciences as proposed by Aristotle (1941) and as handed on to the Middle Ages by Boethius: natural philosophy, mathematics, and theology. Each of these sciences is defined by its subject matter and by its method of procedure. St. Thomas followed the teaching of Boethius on this point; however, as we will see, he made significant additions and alterations.

To grasp the extent of these changes, let us briefly consider Boethius' view of the sciences. According to Boethius, the sciences were concerned with the forms, and the hierarchy of the sciences corresponded exactly to the hierarchy of the forms as found in the real world in their various degrees of separation from matter. Consequently, natural philosophy studied the forms of bodies along with the bodies in which these forms existed. Mathematics studied forms of bodies apart from the matter of the bodies, e.g., lines, circles, etc.

Theology studies forms that are entirely separate from matter, e.g., God (Aquinas, 1963).

From this it is clear that Boethius had based his division of the sciences on what he took to be the objective division of reality. The branches of the sciences corresponded exactly to the order of the forms, which were arranged in an ascending hierarchy according to their degree of separation from matter. For Boethius there was no need to investigate the acts of the intellect by which the different objects of the sciences were comprehended. The intellect merely had to follow the division of the forms that it found ready-made in the world.

In the case of mathematics there was an opportunity for discussing the intellectual act whereby the object was attained, for, while actually existing in matter, mathematical forms were to be considered separate from matter. It was this opportunity which Aquinas exploited to present his own additions and alterations, which were to show the essential role played by the intellect in the determination of the subjects of the sciences. No longer were the sciences to be differentiated solely according to the distinction of the forms as discovered ready-made in the world, but rather according to the distinctions the mind itself made in the course of investigating reality. Each science was still to be differentiated by its own subject. However, by the subject of a science Aquinas did not simply mean the things considered by the science, or its subject matter. Rather, the term "subject" designated the formal perspective (*ratio*) from which the intellect considered the various matters of science (Aquinas, 1963).

If we examine the operations of the intellect and the distinctions it makes, our understanding of Aquinas' division of the sciences will be enhanced. St. Thomas held that the intellect basically performs two operations. First, there is the understanding or apprehension of intelligible objects. By this act we know more or less *what* things are, i.e., we grasp their essences. Second, there is the operation of judgment, by which we compose or divide what we have grasped in apprehension. For example, understanding what green is and what grass is, we unite the two in the affirmative judgment "Grass is green." Or, understanding what an animal is and what a stone is, we divide the two by saying "An animal is not a stone." In making judgments, then, the intellect grasps not only the essence of things but also their existence. That is, the second operation of the intellect deals with how things exist. These two operations correspond to what Aquinas held to be the two principles of reality: the first operation is directed to the essence of a being, and the second focuses on its existence (1963).

When the intellect judges correctly, it conforms to reality. Consequently, in judging, the intellect cannot correctly abstract what is united in reality. The intellect can only correctly judge to be separate what is in reality separate. When the judgments of the intellect fail to conform to reality, it is in error (Aquinas, 1963).

However, Aquinas did hold that by means of the first operation of the intellect one could correctly abstract some things that are not separate in reality. There are two distinct kinds of abstractions. First, there is the abstraction by which quiddities of things are conceived. Here we have what Aquinas referred to as the abstraction of form from sensible matter; this belongs to mathematics. Second, there is the abstraction by which a universal is abstracted from a particular. This belongs to science insofar as the sciences disregard accidental features and treat only of necessary matters. (It should be noted that for Aquinas these two kinds of abstraction correspond to the two modes of union: union of form and matter and union of part and whole.) (Aquinas, 1963).

When that which constitutes the intelligibility of any nature has a relational dependence on something else, we cannot understand that nature apart from that on which it depends. However, if one thing does not depend on another as regards what constitutes the intelligibility of that nature, then the intellect can abstract the one from the other. This remains true regardless of whether the two things are united or separated in reality. Hence, a part can be understood without the whole, as a letter can be understood without a syllable, but not vice versa (Aquinas, 1941).

Let us now turn to the abstraction of the form (*abstractio formae*). St. Thomas points out in Question Five, Article Three of his "Commentary on Boethius' De Trinitate" that ". . . a form can be abstracted from matter if the essential nature of the form does not depend on that particular kind of matter; but the intellect cannot abstract form from the kind of matter upon which the form depends according to its essential nature" (Aquinas, 1963). Since all accidents are related to substance as form to matter, and since every accident of its nature depends on substance, no accidental form can be separated from substance. However, accidents befall substance in a definitely ordered fashion: first quantity, then qualities–after that passivities and motion. Hence, quantity can be considered before the sensible qualities. That is, for Aquinas quantity did not depend upon sensible matter but only intelligible matter. After the accidents have been abstracted, especially the sensible qualities, substance is intelligible to the intellect alone, for substance is beyond the comprehension of the sense powers. The objects of the operation called abstraction of form are the objects of mathematics. For Aquinas the mathematician considers substance as quantified apart from all qualitative characteristics. Such considerations are possible because of the intellect's ability to abstract.

To comprehend this better it will be helpful to turn to one of St. Thomas' later works, the *Summa Theologiae*. While reiterating his position on the operation of the intellect, in the First Part, Question Eighty-five, Article One, "Reply to Objection Two," St. Thomas gives a more detailed account of his doctrine of matter. Aquinas considered matter as being two-fold: common and signate (or individual matter). Common

matter, for example, could be flesh and bones, and individual matter *this* flesh and *these* bones which make up *my* body. The intellect can abstract the species (form) of a natural thing from individual sensible matter. However, it cannot abstract it from the common sensible matter. For example, the intellect abstracts the species of man from this flesh and these bones which belong to the notion of individual. However, when considering the species of man it cannot abstract from flesh and bones, i.e., common matter.

Mathematical species, as opposed to natural species, can be abstracted from sensible matter: both individual and common. However, mathematical species cannot be abstracted from common intelligible matter. Sensible matter is corporeal matter, and it is subjected to such sensible qualities as cold or hot, hard or soft, etc. Since quantity is ontologically prior to all the other qualities, the terminations of quantity, such as number, dimension, and figure, can be considered apart from the sensible qualities. When one studies mathematics, one is abstracting from sensible matter. However, these mathematical terminations cannot be considered apart from substance as subject to quantity. To do so would be to abstract from intelligible matter. Yet, they can be considered apart from any given substance, for this is to abstract from individual intelligible matter (Aquinas, 1941).

Consequently, the abstraction in mathematics is not an abstraction of an accidental form of quantity considered apart from substance, for quantity necessarily inheres in substance. That is, quantity does not exist as an independent form. In Question Forty, Article Three of the First Part of the *Summa Theologiae*, Aquinas writes (1941):

> . . . in the abstraction of form from the matter, both the form and matter remain in the intellect; as, for instance, if we abstract the form of a circle from brass there remains in our intellect separately the understanding both of a circle and of brass.

Let us now turn our attention to the abstraction of a whole (*abstractio totius*), which is performed by the natural philosopher. The *abstractio totius* is the absolute consideration of some essence apart from the individuals whose nature it is. The individuals are, so to speak, "parts" from which nature as a "whole" is abstracted (Aquinas, 1963). Such an abstraction is legitimate if the nature of the whole does not depend on the parts, such that the being of a particular whole is constituted by the composition of a particular part, as a syllable is composed of letters. In other words, such an *abstractio totius* is legitimate insofar as the parts are accidental to the whole. The natural philosopher cannot abstract from the essential "parts" of his subject matter. That is, he cannot abstract from those "parts" that necessarily belong to the subject matter and are included in its definition. For example, since matter and form are both necessary parts of a material being, he cannot abstract from them. However, he can abstract from any given individual, for he does not consider natures as subject to here and now.

Let me expand on this point. The natural philosopher does not study something insofar as it is individuated by matter of determinate dimensions (Aquinas, 1963). To grasp what Aquinas has in mind here we must return to the *Summa Theologiae* where he treats of the twofold division of matter: common and signate (or individual). As mentioned before, an example of common matter could be flesh and bones, and individual matter could be *this* flesh and *these* bones. In natural philosophy the intellect abstracts the species (form) from the sensible matter, but not from common sensible matter. So, for example, the species (form) of man is abstracted from *this* flesh and *these* bones. When speaking of particular flesh and particular bones, one is concerned with a particular individual as such, and not with the species of man. It is the latter which is of concern to the natural philosopher. However, what is important to note is that according to Aquinas' doctrine the species of man cannot be abstracted from common sensible matter, i.e, flesh and bones. A natural species such as that of man cannot be thought apart from indeterminate matter. Hence, the nature of man can be considered without considering particular flesh and particular bones, but it cannot be considered absolutely apart from flesh and bones. Such an abstraction is said to be the abstraction of a universal from a particular, or *abstractio totius,* and it forms the basis of science.

If these remarks are correct, we can draw a few conclusions regarding Aquinas' view of scientific activity. Given his doctrine of substance, we can conclude that for Aquinas the general object of the scientist's studies is the world we all know. Aquinas is not subscribing to some variant of idealism. The different scientific disciplines are generated by the fact that man can consider the things of nature from different perspectives. For example, a psychologist can study the mental processes and emotional and behavioral characteristics of a man and leave out of consideration (abstract from) his vital processes, such as heartbeat. However, in the concrete, no man actually exists in such a split-level fashion. Each of us exists as an unitary whole.

What enables the scientist to develop these different perspectives? Aquinas holds that the division of the sciences can be accounted for when we realize that the intellect can actively leave out of consideration certain characteristics. A more traditional empiricist view which considers the mind as fundamentally passive would find it difficult to account for this division. For example, when we observe a man, we do not observe his emotional and behavioral characteristics apart from his vital processes. We observe a unitary being. Nevertheless, we recognize psychology and physiology as distinct disciplines, and in terms of Aquinas this is because the intellect plays an active role in scientific activity.

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